PB81-164329

Proposed Ground Water Protection Strategy

(U.S.) Environmental Protection Agency
Washington, DC

Nov 80

U.S. Department of Commerce
National Technical Information Service
NTIS.

United States
Environmental Protection
Agency

Office of
Drinking Water
Washington, DC 20460

November 1980

PB81-164229

Water

EPA

Proposed Ground Water Protection Strategy

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA 22161

REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/ODW-3	2.	3. Recipient's Accession No. PB81 164329
4. Title and Subtitle: Proposed Ground Water Protection Strategy			5. Report Date: November 1980
7. Author(s)			6.
			8. Performing Organization Rept. No. ODW - 3
9. Performing Organization Name and Address: Office of Drinking Water, U.S. EPA, 401 M Street, S.W., Washington, D.C. 20460			10. Project/Task/Work Unit No.
			11. Contract(C) or Grant(G) No. (C) (G)
12. Sponsoring Organization Name and Address: U.S. EPA, 401 M Street, S.W., Wasington, D.C. 20460			13. Type of Report & Period Covere: Development Document
			14. November 1980

15. Supplementary Notes

16. Abstract (Limit. 200 words)

Public hearings on the Environmental Protection Agency's Ground Water Protection Strategy were held in five U.S. cities during January, 1981. This document outlines the proposed strategy with a discussion of the assumptions, goal and objectives of the strategy, management approaches, and technical requirments. An introductory section provides background material on ground water and involvement of states, industry, public interest groups and others.

Two earlier documents on the strategy are also available: Planning Workshops to Develop Recommendations for a Ground Water Protection Strategy - (NTIS Acession No. PB-81-122624) and Planning Workshops to Develop Recommendations for a Ground Water Protection Strategy: Appendices (NTIS Acession No. PB-81-122616).

17. Document Analysis a. Descriptors

Ground Water/Water Resources/Hydrology

b. Identifiers/Open-Ended Terms

Ground Water Protection Strategy

c. COSATI Field/Group

18. Availability Statement: Release unlimited

19. Security Class (This Report) unclassified	21. No. of Pages 78
20. Security Class (This Page) unclassified	22. Price

(See ANSI-Z39.18) See Instructions on Reverse

OPTIONAL FORM 272 (4-77) (Formerly NTIS-35) Department of Com...

PROPOSED GROUND WATER PROTECTION STRATEGY

U. S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF DRINKING WATER
NOVEMBER 1980

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

November 18, 1980

OFFICE OF WATER
AND WASTE MANAGEMENT

Dear Reader:

This proposed Ground Water Protection Strategy has been formulated over the past months with the active participation of a number of State and local government officials, business, environmental, academic and public interest groups. When adopted in its final form, the strategy will serve as EPA's policy framework, particularly in relationships with the States, in the area of ground water protection.

A series of public hearings are now scheduled to seek even wider public participation and advice. At these hearings, or through written responses, we are soliciting comments on all aspects of the proposed strategy which sets forth a division of responsibilities at the Federal, State and local levels. We especially seek comment on the following questions:

1. Is the policy goal based upon "present and projected future uses..." a sound and workable goal? Conversely, should alternative goals be selected, such as non-degradation for some or all ground waters? What would be the practical implication of such approaches?

2. Are State strategies a useful vehicle for helping to improve State efforts toward ground water protection? For focusing EPA and other federal assistance on State and local concerns?

3. Is ground water classification an effective and useful approach to setting priorities on the protection of significant ground waters? To identifying appropriate areas for siting new hazardous waste disposal facilities and other facilities with the potential for seriously affecting ground-water quality?

4. What are the technical impediments to carrying out a classification system? Are there social, economic or political impediments? What steps should be taken at the Federal, State or local levels to overcome such impediments?

5. What criteria might be devised to ensure appropriate participation of local authorities in the formulation of State ground water protection strategies and in classifying ground waters?

6. Is the proposed system for developing national criteria for ground water classification appropriate for State implementation? Are the associated Federal, State and local responsibilities applicable and useful or should alternative approaches be considered?

7. Is there any basis for concern that the proposed Ground Water Protection Strategy (or any part of it) would preclude or hamper EPA or the States from acting under their "imminent hazard" statutes to protect the public health or to deal with significant environmental threats?

8. Should EPA seek new Federal legislation to implement this strategy (or selected parts of it) immediately or should we await additional experience as outlined in the proposed strategy?

9. Are there areas of ground water protection into which the Federal government should not intrude itself? What would be the impact of leaving these areas exclusively to state and local control?

To submit public comments or obtain further information, write Ms. Marian Mlay, Associate Deputy Assistant Administrator for Drinking Water, WH-550, Environmental Protection Agency, 401 M St., S.W., Washington, D.C. 20460. Expressions of interest in testifying at one of the hearings may be telephoned to 800-424-9159.

Public hearings will be held as follows:

January 12-13, 1981	Atlanta Marriott Courtland at International Blvd. Atlanta, GA
	Denver Hilton 1550 Court Place Denver, CO
January 15-16, 1981	First International Bldg. 1201 Elm Street 29th Floor Conference Facility Dallas, TX
	Social Security Auditorium 4th and Spring Garden Streets Philadelphia, PA
January 29-31, 1981	Health and Human Services Auditorium (North) 330 Independence Ave., S.W. Washington, D.C.

All hearings will begin at 8:30 a.m., local time.

We appreciate your interest and concern with ground water protection and invite your participation in this crucial issue. The public comment period will close on February 18, 1981.

Eckardt C. Beck
Assistant Administrator
for Water and Waste Management
November 18, 1980

CONTENTS

EXECUTIVE SUMMARY

PART ONE: PREAMBLE

I. INTRODUCTION

II. INVOLVEMENT OF STATES, INDUSTRY, PUBLIC INTEREST GROUPS, AND OTHERS

III. BACKGROUND ON GROUND WATER

PART TWO: STRATEGY

IV. INTRODUCTION TO THE STRATEGY

V. ASSUMPTIONS

VI. GOAL AND OBJECTIVES

VII. MANAGEMENT APPROACH

VIII. TECHNICAL REQUIREMENTS

IX. NEXT STEPS

EXECUTIVE SUMMARY

GROUND WATER PROTECTION STRATEGY

The U.S. Environmental Protection Agency (EPA) is proposing this ground water protection strategy in response to a growing concern over the plight of the Nation's ground waters. The public, along with government officials and experts in the field, is aware that instances of ground-water contamination have been discovered in most sections of the country. They are concerned that ground water is vulnerable to even more widespread contamination in the future as our population and industry continue to grow, thus increasing the already staggering volume of waste to be disposed of.

The problem is national in scope. Approximately half of the country's population relies on ground water for its drinking water. And yet protection of those water sources has been inadequate, in large measure because until recently conventional wisdom believed that nature protected our underground water much more than it actually does. Unfortunately, most of our activities on the land directly affect the quality of the ground water underneath.

With growing frequency, newspapers are reporting new instances of ground-water contamination. Dramatic problems such as Love Canal and the Valley of the Drums have attracted national attention, but numerous local situations of ground-water contamination are also of concern. Some examples are:

- South Brunswick, New Jersey, where one-third of the local water supply for this community of 18,000 is unusable now as a result of contamination by a half gallon of solvents daily for a five to ten year period.

- St. Louis Park, Minnesota, where creosote contamination from a manufacturing operation built up over many years resulting in some drinking water wells being closed due to a tar-like taste and the discovery of relatively high levels of possible carcinogens in the ground water.

- Thirty square miles of the shallow aquifer table underlying the Rocky Mountain Arsenal near Denver, Colorado, are contaminated by chemical by-products from the manufacture of pesticides and herbicides, resulting in temporary abandonment of a number of domestic, stock, and irrigation wells, and final abandonment of two wells.

- Fifty-one cases have been filed by EPA and the Department of Justice to force responsible parties to clean up dangerous hazardous waste sites. Of these, 28 involve pollution of ground water, about half of which are drinking water sources.

The contaminants in all these cases are synthetic organic chemicals. Some of these compounds are cancer-causing in laboratory animals. Some are known human carcinogens. Many are highly toxic. Hundreds of thousands of chemical compounds are in use; little is known about the health effects of most, particularly about the impact on human health of various combinations of compounds.

The most frequently found industrial solvents are known to be dangerous to human health. When they appear in ground water they are often in concentrations sufficiently high to present a significant risk to health. Aquifers do not provide the natural dilution or flushing that occurs in surface waters. A contaminant that penetrates ground water tends to form a "plume" of highly contaminated water, moving slowly through the aquifer for years, even decades. Managing instances where contamination is discovered to avoid future public health problems is a major task for the future which is beyond the past experience of most units of state and local governments.

EPA is under considerable pressure to assist in the cleanup of areas where ground-water problems have been discovered and to take action to find potential threats and prevent future instances of contamination. This is not a simple task: detecting and cleaning up contamination are difficult and costly operations. And ground water underlies almost the entire country. The little we have learned in recent years has taught us three sobering lessons: the problem is real and dangerous; our present state of knowledge to deal with these problems is limited; and present programs, authorities and resources are inadequate. It is clear that while the cost of protecting ground water will be high, the cost of continuing to ignore the problem is even higher and clearly unacceptable from a public health perspective.

As states mount more aggressive efforts to conduct monitoring and ground-water quality sampling in the future, and as more ground water monitoring is conducted pursuant to the hazardous waste program, more local instances of ground-water contamination will be discovered. The more states look for such problems, doubtlessly, the more they will find. Also, normal patterns of increased industrial activity will expand the problem. Finally, a significant impact could be caused by other environmental regulations which are closing off the air, surface waters, oceans, and other media as acceptable areas for waste disposal.

The dimensions of the current ground-water problem are becoming unmanageable. There is no single Agency at any level responsible for ground water protection. Ground water management is carried out on a state-by-state basis, with different approaches and implementation in every state. With the growing number of instances of contamination and the addition of new EPA programs affecting ground water, the states and localities may soon be overwhelmed.

ADDRESSING GROUND WATER PROTECTION

Numerous Federal laws and state programs deal in some way with ground water protection and management. Some parts of the Clean Water Act (CWA) -- specifically, Sections 208 and 106 -- have strengthened state abilities to protect ground water. The Safe Drinking Water Act (SDWA) through its underground injection control and sole source aquifer protection provisions and the Resource Conservation and Recovery Act (RCRA) provide for control of certain hazardous practices and some protection for highly vulnerable areas. Other EPA statutes which regulate toxic substances and pesticides and the surface mining and uranium mill tailings programs administered by other Federal agencies also contribute protection provisions.

In addition, EPA has now before Congress a Superfund program which, when enacted, would help resolve problems caused by abandoned waste disposal sites. This proposal provides the Federal government with both the authority and the resources to clean up abandoned sites; permits speedy action, prior to long judicial proceedings, to prevent and abate situations that may threaten public health; and imposes joint, several, and strict liability on those who caused or are causing the problem. This program would serve as both a deterrent and as a means of recovering cleanup costs.

EPA is pursuing the imminent hazard provisions of existing statutes to protect public health and the environment. It is accelerating its research and development efforts and taking other steps described in greater detail in this document. Many states are expanding their ground water protection efforts by implementing federally delegated programs as well as devising protection programs for some sources of contamination not regulated by Federal statute.

Given the extent of the problem, with its complexities and the potential for increasing threats to public health and sensitive ecological systems, it is clear that significantly increased attention must be given to this issue to manage instances where contamination is detected and to initiate preventive programs to avoid ground-water contamination in the future.

Late last year the Administrator of EPA, Douglas Costle, began the formulation of a ground water protection strategy, calling upon representatives of state and local government, business and industry, environmental and academic groups and the public to help. He felt that we must obtain better insights into this problem and clarify how, and in what policy direction, our nation should proceed. It is hoped that this strategy will help to bring focus to uncoordinated efforts, better enabling us all protect this resource. This strategy should help to develop more effective relationships among Federal, state and local governments in working together on these problems.

This strategy is not a detailed implementation plan. It addresses broad policy issues rather than narrow technical choices. It emphasizes a preventive approach rather than concentrating on the clean-up of known sources of contamination; not that the latter is not a vital need, but it is already beginning to occur as a consequence of existing legislation and the proposed Superfund program. The strategy is an attempt to look to the future to assure that the quality of ground water is protected as a resource for future generations and to explore new approaches to ground water protection.

The strategy focuses on key issues that are critical to ground-water quality in order to have the most impact. For example, it is not intended to deal with tap water issues, such as current or proposed drinking water standards or treatment technologies. Likewise, the ground-water depletion issue is not a major focus. While depletion is a critical issue in many sections of the country, it relates to this strategy only as a problem that can contribute to ground water quality problems, not as an independent issue.

EPA is not proposing new Federal legislation. The immediate challenges seem to be ones of coordination, follow-through and implementation. As implementation of the existing programs is completed and more time and effort are devoted to the protection of ground water, the need for additional legislation or significant new programs will be assessed.

Given the far-reaching aspects of the problem, the ground water protection strategy is being developed with broad public debate and participation. Workshop discussions, which included some 80 participants from all levels of government and from industry, public interest groups, and academia, were instrumental in drafting this strategy. Public comments based on public hearings and the publication of this proposal in the Federal Register will be considered in the final formulation of the ground water protection strategy.

GOAL AND OBJECTIVES

The proposed goal for the ground water protection strategy is:

> "It shall be the national goal to assess, protect, and enhance the quality of ground waters to the levels necessary for current and projected future uses and for the protection of the public health and significant ecological systems."

This goal recognizes that all ground water is not of the same value. The goal is primarily preventive, rather than curative. Of course, newly discovered ground-water quality problems must be remedied to the extent possible to mitigate against imminent hazards, but the long-term objective of the strategy is to prevent ground-water contamination before it occurs, rather than to clean it up after the fact.

The objectives of this ground water protection strategy are:

By 1985

- To initiate ground water protection strategies in all States, aimed at meeting the goal and the long-term objectives and to develop the necessary institutional capacities (resources, personnel, legal authorities, etc.) at the State and local levels.

- To implement fully the currently enacted Federal regulatory programs which affect ground water (e.g., Resource Conservation and Recovery Act (RCRA), Underground Injection Control Program (UIC), and Surface Mining Reclamation Act) and Superfund when enacted.

- To launch efforts to evaluate ground-water quality, to ameliorate the most hazardous conditions discovered, and to develop and implement technical and administrative methods of managing newly discovered plumes of ground-water contamination.

- To provide a process whereby State and local governments and the public, in specific situations, with adequate public health and environmental protection, can set priorities among competing activities which may use or contaminate ground water.

By 1990

- To ensure that appropriate levels of protection are being provided for the ground water resources in each State and that each State has a complete program which has been fully implemented to manage all ground water.

MANAGEMENT APPROACH

The management approach proposed in this strategy includes four key elements:

First, state ground water protection strategies to be developed by the states. States will be encouraged to devise strategies which identify how this goal, as well as state and local goals and consistency across state boundaries, will be met through specific regulatory and other program actions at the state and local levels. These will be fostered and may be partially funded as part of the State/EPA Agreements (SEAs).

Second, ground-water classification. The principal premise of a classification system is that different levels of protection can be provided to ground water according to a number of factors. The classification process should help sort out the high priority ground-water areas for high levels of protection and for first attention and investment, and assist in identifying those areas least environmentally sensitive for siting of future waste disposal facilities or other potentially polluting activities.

Classification decisions about the appropriate levels of protection for individual ground waters would be based on such factors as: present and projected future uses; current quality; yield, or volume of water available; availability of alternative water supplies; and vulnerability to contamination, that is, the degree of natural protection afforded by local hydrology and geology.

Until a classification system is developed with full public participation and adopted, EPA will maintain a policy that where ground water is currently of drinking water quality or better, it will be provided protection to ensure that its utility for this use is not impaired.

Third, minimum national requirements for selected high priority problems. There are some problems which, on a national scale, are so severe and complex that national standards are appropriate. Examples include

highly toxic chemicals and pesticides where product bans or restrictions are appropriate. The Underground Injection Control Program and the Hazardous Waste Regulations under RCRA provide national requirements for selected problems, including their imminent hazard provisions. Other ubiquitous problems will be reviewed for possible federal action.

Fourth, EPA administrative action. This includes EPA action to coordinate and bring consistency among existing EPA and other federal programs with ground water protection authorities. It will include action by EPA to encourage and assist states to expand monitoring to detect contamination, to begin developing ground water protection strategies through State/EPA Agreements, to increase research and development and, to the extent possible, to provide technical assistance to state programs. In addition, EPA intends to continue its involvement of the public and numerous institutions in the implementation of this strategy.

TECHNICAL REQUIREMENTS

A range of technical requirements will be needed under this ground water protection strategy due to the variety of problems affecting ground-water quality.

There are four types of technical requirements which are expected to be used extensively under this strategy. (Other approaches, such as economic incentives, may also prove effective.) The four principal approaches are siting practices, best management practices, technology-based or effluent standards, and performance standards. These are described in the text that follows.

PART ONE: PREAMBLE

I. INTRODUCTION

THE SETTING FOR STRATEGY DEVELOPMENT

The Environmental Protection Agency (EPA) is concerned about the growing evidence that ground water, a resource that has always been considered relatively pollution free, is widely contaminated. The nature of that contamination may pose significant public health problems and threaten critical ecological systems. Since ground-water contamination is usually difficult to contain or control, its prevention, and where possible its early detection, is a crucial environmental and public health responsibility.

Although there are some existing ground water protection measures authorized by the Clean Water Act (CWA), an Underground Injection Control (UIC) program recently instituted under the Safe Drinking Water Act (SDWA), and a hazardous waste program developed under the Resource Conservation and Recovery Act (RCRA) and parallel actions among some states to varying levels, fundamental policies concerning how this nation should ultimately address the broad issue of groundwater protection have not yet been determined. In carrying out a ground water protection strategy, EPA would like to build on these new Federal programs and undertake a broad cooperative effort with state and local governments. The EPA also will continue to encourage participation of affected industries, businesses, and public services; concerned environmentalists; public interest groups; and professionals in related fields.

Because of the far-reaching effects of the problem, the ground water protection strategy is being developed with extensive public debate and participation rather than by issuing an Agency-drafted strategy for public comment. This approach included workshop discussions of the policy choices that appear critical to the formulation of a ground water protection strategy. Drawing upon these consultations and other comments, EPA is proposing this strategy for further public consideration before final issuance and implementation.

The problem at hand is immense and represents decades of neglect or at least ignorance. Protecting ground water is a long-term, open-ended imperative. This strategy represents an important first step in a lengthy process which must involve the collaboration of all appropriate institutions. In addition, as the country enforces its controls on the disposal of waste

into our surface waters, oceans, and the air, the land becomes the last unregulated medium for waste disposal. Simultaneously, more environmentally satisfactory disposal schemes for various wastes, particularly hazardous wastes, must be identified.

The ground water protection strategy must have a national scope. It is important to note, however, that a national strategy is not synonymous with a Federal strategy. Rather, it implies a general consensus on the part of those concerned--Federal, State and local governments; business, industry and the public--as to what problems are to be addressed; what objectives are to be achieved; and what constitutes the most effective, efficient, and feasible action program to alleviate the problem. Central to the construction of a national strategy is a specification of the roles to be played by participants, including governments, industry, and the general public. The distribution of these roles depends on many factors--among them history, current law, capacity to provide needed resources, and the extent to which the problems are being addressed through current efforts.

For ground water protection, EPA has in mind both a national and a Federal strategy. A national perspective will help to limit the Federal role to functions which are appropriate and supportive of related efforts, most particularly the efforts of State and local governments. A national approach also responds to the mandates of the President's June 6, 1978, Water Policy Message, which directed Federal agencies to expand Federal-State dialogue and cooperation on ground water issues. The strategy should clearly recognize the larger context in which EPA works--on the Federal level and with State and local governments--and provide the framework within which EPA decision-making on ground water protection should take place.

HISTORY OF THE STRATEGY TO DATE

The planning process for this proposed strategy began in the winter of 1979 when the EPA Administrator assigned the Office of Water and Waste Management (OWWM) responsibility for developing a ground water protection strategy under the direction of the Assistant Administrator for Water and Waste Management and the Deputy Assistant Administrator for Drinking Water. Administrator Costle stressed that a ground water strategy should:

- Look well into the future to assure that the quality of ground water is protected as a resource for future generations;
- Explore with an open mind alternative approaches to ground water protection and not be bound by existing policy or law;

- Concentrate on broad policy issues rather than narrow regulatory or technical choices;

- Fully involve representative state officials as well as other concerned groups through direct participation;

- Stress cooperation and interaction with other affected institutions; and

- Recognize the relationship between ground water and surface waters, including wetlands.

The strategy was to be focused on key issues that are critical to ground-water quality. For example, it is not intended to deal directly with tap water issues, such as current or proposed drinking water standards or treatment technologies. Likewise, the ground-water depletion issue is not a major focus. While depletion is a critical ground water issue in many sections of the country, it relates to this strategy only as a problem that can contribute to ground-water quality problems, not as an independent issue.

To fulfill the requirements above, EPA outlined a three-phase approach.

- Phase I, which has been completed, involved data gathering by four task groups and preliminary consultation with representative states and organizations. A Policy Committee composed of all Deputy Assistant Administrators with ground-water responsibilities, three Regional officials and a USGS representative was established to lead this effort, along with work groups to provide staff assistance in assembling the needed information.

- Phase II, which took place in June, consisted of a pair of workshops in which eighty representative and knowledgeable persons developed recommendations leading to this document.1/

- In Phase III this proposed strategy is being published in the Federal Register and widely distributed. Public hearings on the subject will be held in five locations throughout the nation in January, 1981.

1/ Planning Workshops to Develop Recommendations for a Ground Water Protection Strategy and Appendices, EPA, Office of Drinking Water, Washington, D.C., June 1980.

- Concentrate on broad policy issues rather than narrow regulatory or technical choices;

- Fully involve representative state officials as well as other concerned groups through direct participation;

- Stress cooperation and interaction with other affected institutions; and

- Recognize the relationship between ground water and surface waters, including wetlands.

The strategy was to be focused on key issues that are critical to ground-water quality. For example, it is not intended to deal directly with tap water issues, such as current or proposed drinking water standards or treatment technologies. Likewise, the ground-water depletion issue is not a major focus. While depletion is a critical ground water issue in many sections of the country, it relates to this strategy only as a problem that can contribute to ground-water quality problems, not as an independent issue.

To fulfill the requirements above, EPA outlined a three-phase approach.

- Phase I, which has been completed, involved data gathering by four task groups and preliminary consultation with representative states and organizations. A Policy Committee composed of all Deputy Assistant Administrators with ground-water responsibilities, three Regional officials and a USGS representative was established to lead this effort, along with work groups to provide staff assistance in assembling the needed information.

- Phase II, which took place in June, consisted of a pair of workshops in which eighty representative and knowledgeable persons developed recommendations leading to this document.1/

- In Phase III this proposed strategy is being published in the Federal Register and widely distributed. Public hearings on the subject will be held in five locations throughout the nation in January, 1981.

1/ Planning Workshops to Develop Recommendations for a Ground Water Protection Strategy and Appendices, EPA, Office of Drinking Water, Washington, D.C., June 1980.

- The final strategy is expected to be published later in the year.

WHAT THE STRATEGY SHOULD PROVIDE

The ground water protection strategy should provide:

- A clear enunciation of the problems and issues being addressed and the goals and objectives to be achieved;
- A greater national recognition and understanding of ground-water problems;
- A national program with fully defined Federal and state roles;
- A comprehensive Agency ground water protection policy that will apply to all programs affecting ground water from data collection to management;
- A stronger set of relationships among Federal, state, and local governments; and
- A meaningful short-term action plan and a strategy for dealing with ground-water problems over the long term.

The strategy is intended to provide a policy basis for future decisions such as budget allocation, organizational actions, and regulatory steps. The strategy should provide a framework to tie together regulatory efforts under various legislative authorities. Any EPA regulations developed in carrying out this strategy will be subject to the normal review process as they are issued under each statute. Hence the rule-making process will be carried out for each regulation but will reflect the policies in the final ground water protection strategy.

STRUCTURE OF THIS PROPOSED STRATEGY

This strategy paper is organized in two parts. The first -- Preamble -- describes in some detail the process used in developing the strategy and reviews the Workshops held in June. It is followed by a background chapter on ground-water use and contamination.

The proposed strategy is outlined in the second section. The introduction includes the rationale for the strategy, the first chapter presents the basic assumptions which underlie the strategy, and the following chapter sets forth the goal of the strategy and reviews the objectives which the strategy aims to accomplish. The more detailed elements of the strategy are covered in the remaining chapters which outline the management approach and the technical requirements.

II. INVOLVEMENT OF STATES, INDUSTRY, PUBLIC INTEREST GROUPS, AND OTHERS

From the outset, the ground water strategy development process has sought to involve as many viewpoints as possible. Individuals representing government at all levels, members of industry, public interest groups, academic experts and others were consulted and their advice was used to construct the strategy presented below. The process proceeded in three phases. The contribution of each of these phases is discussed in the sections which follow.

PHASE ONE: WINTER AND SPRING 1980

Throughout Phase I of the formulation of the ground water protection strategy, EPA sought involvement of groups and individuals outside the Agency. Over 100 key organizations interested in ground water protection were contacted to identify the issues and the range of options which should be addressed in the strategy.

In order to gain the perspective of a cross-section of state governments, EPA made a particular effort to consult with as many state officials as possible. Members of state legislatures, public health and environmental protection departments, water resources boards, engineering departments, state geological surveys, and other state offices were included.

The interests of business and industry were solicited. Through industry associations and individual companies, those industries most likely to be affected by the ground water protection strategy were identified. In particular, these include the chemical, oil and gas, mining, water utility, agriculture, waste disposal, textile, and building industries.

Many public interest groups including those representing environmental concerns were also contacted in preparing for the workshops.

The National Drinking Water Advisory Council and EPA's Science Advisory Board were also consulted. Representatives from the Council assisted in developing issues for consideration and in selecting workshop participants.

Local government officials, those who make local decisions affecting ground-water quality, were involved. Organizations representing local officials were consulted, and mayors, council members, and court officers were contacted directly.

To ensure that academic knowledge and technical expertise were brought into the workshop research, experts including university professors, practicing hydrogeologists, and engineers were consulted by EPA.

In addition, a role for other Federal agencies was provided. Those federal agencies with a stake in the ground water protection strategy or which could represent related Federal interests were consulted, and officials participated in the strategy process. These included the Council on Environmental Quality, the U. S. Geological Survey, the Water Resources Council, and the Department of Agriculture.

Throughout early 1980 as these contacts were being made, EPA officials compiled information on ground water and wrote detailed background papers on ground-water use and contamination, on state and Federal law and on ground water research and development. The results were the working papers and appendices published for use at the June workshops. The conference workbook focused on five key topics and set the structure for the workshops. The topics listed in Table II-1 enabled the workshop participants to focus on a logical sequence of decisions leading to a comprehensive strategy. The five topics were goals, management approach, technical requirements, Federal and state roles, and near-term implications. The workbook identified options in each of these areas to form the basis of discussion during the workshops. The options are listed in Table II-1 in abbreviated form. In addition to the conference workbook, EPA has published a set of appendices which contained the working papers written as background.1/ These appendices contain ten papers which analyze in depth related issues such as ground water use in the U.S., synthetic organic contamination in ground water, EPA and other Federal laws pertaining to ground water, state and Federal programs by pollution source, current state ground water management programs and research and development.

PHASE TWO: THE JUNE WORKSHOPS

The two workshops conducted June 22-28, 1980, included representation from groups concerned with ground water protection--those contacted during Phase I. The 80 participants provided a cross-section of interests, opinion and knowledge of ground water protection.

Those invited to the workshops offered diverse backgrounds and organizational affiliations. All areas of the country were represented; there was a special effort, however, to include the western states where water resource issues have long been a major concern for state and local officials.

1/ Ibid.

Table II-1

SUMMARY OF INITIAL OPTIONS FOR DEVELOPING A GROUND WATER PROTECTION STRATEGY

Goals (select one)	Mechanisms: Management Approach (select one or more)*	Mechanisms: Technical Requirements (select one or more)*	Federal/State/Local Roles (select one or more)*
• To protect all ground waters at their present levels of quality (i.e., nondegradation)	• Uniform Requirements Everywhere	• Best Management Practices (BMP's)	• States take primary responsibility for implementation of federally developed national standards
• To assure that all ground waters are protected everywhere up to some specified level (e.g., a drinking water standard)	• Classification of Ground Waters	• Technology-Based or Effluent Standards	• States prepare and submit program plans for federal approval in response to federal minimum requirements
• To protect ground waters to the levels necessary for projected future uses	• Classification of Contaminants	• Ground Water Quality Standards	• States prepare individual program plans consistent with broad federal guidelines, subject to federal approval primarily on procedural grounds
• To protect only those ground waters that are used as drinking water sources, and to rely on monitoring or treatment for use of unprotected ground waters	• Classification of Sources of Pollution	• Economic Incentives and Other Approaches.	• State and local governments set and enforce standards consistent with broad federal goals; the federal government provides technical assistance and support
			• States develop plans and programs; the federal government provides support and technical assistance only

*Select or develop one option, or select more for different categories of problems, etc.

The participation of Federal officials in the workshop was limited in several respects. The only Federal attendees were those representing the four federal agencies mentioned above. EPA staff members served only as resource persons.

During the closing sessions of the workshops, senior EPA officials attended to hear the recommendations of the participants and to ask questions for clarification. These final sessions provided senior EPA management with valuable insights into the preferences of the workshop participants with respect to each element of the ground water protection strategy.

REVIEW OF WORKSHOPS

Two identically structured, three-day workshops were held. Each workshop included approximately 40 participants who were divided into four groups of about 10 members each. The work groups were carefully chosen so that each group included representatives of the principal viewpoints. Following the opening session which included all participants, each of the work groups was assigned to write a goal statement for the ground water protection strategy. The work group chairpersons then reported back to the whole session. This process--work group assignments to develop reports on each of the sequential elements of the strategy followed by reports to the assembled session--continued during the three days and concluded with the final presentations of each of the four work groups on their recommendations for the strategy as a whole. These oral reports from the eight work groups (four groups at each of two sessions) constitute the major results of the workshop.

The strategy which is proposed in Part II of this paper reflects in general terms, the recommendations of the eight work groups. The groups presented similiar statements of what should be the strategy's goal and the management approach needed to move toward this goal.

Goals

The principal view expressed concerning the goal for the ground water protection strategy was that the third option shown above in Table II-1 contained most of the appropriate elements of a goal statement. There was general agreement that the protection of ground water should be related to existing quality and to present and projected future uses.

The participants expressed views which ranged from advocacy of total non-degradation to support of little or no protection of ground-water quality. The extreme views were held by few participants, however, for the majority supported very similar goal statements.

Management Approach

Virtually all participants stressed the need for flexibility to accommodate State and local differences. Those differences include natural ground-water quality, vulnerability to contamination, degree of natural protection, availability of alternative sources of water, uses of ground water, and the relative priority of competing uses. Most participants felt that the best vehicle to accommodate these differences was to base the level of protection on the water quality levels needed to support the current and projected future uses of ground water. EPA has accepted this concept and the rationale that in this way ground water will be protected where protection is needed to the levels which are necessary.

A theme which emerged was that programs or requirements for protection ought to be based on the uses which will be made of the ground water. Accordingly, EPA is proposing ground-water classification as a primary element in the strategy. (In order to avoid the administrative and technical burden of classifying all ground waters at one time and to avoid delays in launching the ground water protection program, a rebuttable presumption will be used to focus classification efforts only on those areas in which either a siting decision needs to be made or a more stringent level of protection is desired.)

By linking protection to uses and existing quality, the proposed goal provides for explicit public decisions on competing uses of ground water, which could then lead to differing levels of ground water protection. While strict protectionists generally opposed this concept, most persons consulted solidly supported it. Those from certain sections of the country, especially the West, felt that it was essential. The Agency has agreed that it is important to incorporate this flexibility into the program, and that such decisions are best made as explicit public decisions at the State and local levels. A relatively small number of ground-water trade-off decisions are expected to be made, but they should receive the amount of attention they deserve.

It should be noted, however, that EPA believes that no one has the right to pollute the ground water in such a way as to create a significant risk to public health or critical ecological systems. For this reason EPA will continue its efforts to prosecute violations of the imminent hazard provisions under RCRA and SDWA wherever serious contamination situations are detected.

Another theme which emerged was that there are some ground-water threats of such high priority that they warrant strong national action. Typically these were described in general terms as situations dealing with highly toxic chemicals or hazardous wastes. In some instances Congress has recognized these, too, and adopted national legislation. EPA has agreed and included in the strategy provisions for the identification of further high priority problems which might warrant national attention and action and has provided a process for their consideration.

Technical Requirements

The general view of the workshop participants was that a variety of technical requirements would need to be a part of successful ground water protection strategy. The breadth of these requirements was due to the diversity of sources of ground-water pollution and the consequent diversity of technical approaches needed to limit or eliminate their contaminating effects.

The majority of participants favored these three types of technical requirements:

- Best management practices, or operating and design requirements for activities which may contaminate ground water, particularly area-wide sources of contamination.

- Technology-based or effluent standards, or specific limits on contaminant quantities from industrial or other activities.

- Economic incentives to reduce ground-water contamination. Few details were offered on how economic incentives should be structured.

These three requirements were viewed as collectively adequate to accomplish the goal of ground water protection. Few participants suggested that only one of these technical requirements alone would be adequate. Many suggested greater attention be given to the development of performance standards where practical.

One technical requirement--the establishment of numerical ground-water quality standards--was judged by many participants to be generally beyond the limits of current knowledge. These concerns focused primarily on the limited coverage of drinking water standards and on the ability of models to reliably relate discharges in ground water to changes in quality at the point of withdrawal. Many participants indicated that ground-water

quality standards would not be a viable basis for the strategy for at least five to ten years, although the development of additional maximum contaminant levels and advisories on safe drinking water levels should be accelerated. These will serve as a major tool in assessing the magnitude of risk posed by the measurable migration of contaminants from existing facilities.

Federal, State, and Other Roles

In dealing with this topic, the workshop participants and others suggested many approaches. Several participants, including some from state governments, felt that the states should be free from specific Federal requirements beyond existing Federal legislation. Some states felt that the appropriate Federal role is to provide research and technical assistance. Others felt that a strong Federal role was necessary to assure program consistency between states and to encourage reluctant states to adopt adequate ground water protection programs. Others expressed views which fell between these options.

In response to this diversity of opinion, EPA is recommending Federal, state, and other roles which leave the state with the key responsibilities for designing and implementing programs. The proposed Federal role will be for EPA to provide guidance to states to encourage the development of state strategies, to assure implementation of existing Federal ground-water related programs, to establish ground-water classifications as part of the management approach to accelerate R&D programs where appropriate, and to continue to initiate Federal "imminent hazard" enforcement actions to clean up hazardous waste sites and other contamination polluting ground water. In addition, some participants suggested that EPA carry out a ground water program at some time in the future if states do not establish an adequate program. If EPA were to take over a state ground water program beyond the current authorities of RCRA, CWA, and other laws, new legislation would be needed to support it.

III. BACKGROUND ON GROUND WATER

Ground water is the least understood of our major natural resources. In both science fiction and courts of law traditionally it has been erroneously described and treated as "underground streams." Despite the general lack of awareness and understanding surrounding it, ground water is an important source of the nation's water supply. Its use has grown sharply over the years but its availability has decreased because of pollution and, in some areas, because of depletion.

This chapter presents a brief description of ground water as a resource, including past and future use projections. It also describes damage that has been done to ground water by various contaminants and pollution sources, discusses the difficulty of protecting and cleaning up ground waters, and outlines what Federal and state programs exist that can address ground-water pollution problems.

GROUND WATER USE

Ground water has become an increasingly valuable resource over the past 35 years. Ground-water withdrawals in the United States quadrupled from 21 billion gallons per day in 1945 to 82 billion gallons per day in 1975. The increase from 68 to 82 billion gallons per day in the five-year period 1970-1975 was particularly pronounced.

Most of this increased use can be attributed to agricultural irrigation. In 1950, 21 billion gallons per day of ground water were used for irrigation purposes. In 1975, 57 billion gallons/day--or approximately 70 percent of the ground water withdrawn nationwide--were used for irrigation activities, and ground water constituted 41 percent of the total amount of water so used. Since ground water is withdrawn primarily for irrigation purposes, the total amount used is bound to be affected by change in agricultural policy and practices.

Increased energy costs, as they increase the cost of pumping ground water for irrigation purposes, will affect this major sector of ground water use. Data indicate that for a 300-foot lift in the Central Valley of California pumping energy costs increased from $3.30 per acre-foot in 1970 to $12.00 per acre-foot in 1980. In the short run, such energy price impacts in the agricultural sector may manifest themselves as an increase in the amount of dryland or unirrigated farming and as a shift in the type of crops grown. For example, along the Ogallala Aquifer in Texas, cotton, a water-intensive crop, is being replaced with sorghum and other crops that are less water intensive.

For the future, total ground-water withdrawal projections range from 70 to 100 billion gallons per day in both 1985 and 2000.1/ The range is expected to remain the same during this 15-year period because the cost of pumping will serve as a constraint on the demand for ground water.

SOURCES OF GROUND WATER CONTAMINATION

Ground water can be contaminated by a variety of sources. The degree of threat depends on the nature (toxicity) and volume of the contaminant that is generated by a particular site or activity, the characteristics of the material underlying the site, and the particular geological and hydrological conditions of the area. For instance, a landfill that is underlain by 200 feet of impermeable clay would pose little threat to an artesian aquifer beneath the clay, but a landfill located on a permeable material with a shallow depth to ground water could pose a serious threat.

Contamination by Municipal and Industrial Waste Disposal Sites

Disposal of municipal and industrial waste on the land is a source of serious concern because of the large volumes of waste, the large number of sites involved, the hazardous nature of much of the waste, and the inadequacy of the precautions taken to protect ground water at many of the sites. While estimates of the magnitude of this problem vary, the following data are illustrative:

- A 1979 study by an EPA contractor indicated that 32,000 to 50,000 disposal sites may contain hazardous waste, and that of these 1,200 to 2,000 could pose potential danger to public health or to the environment.

- EPA estimated that approximately 57 million of the 378 million tons of liquid and solid industrial waste generated in 1978 were hazardous and that this amount will grow by 3.5 percent each year. About 80 percent of these hazardous wastes are improperly disposed of in landfills or lagoons and pose a threat of ground-water contamination.

1/ These projections are based on the Water Resource Council's First and Second National Assessments and ground water data generated by the United States Geological Survey.

- Very few land disposal sites are lined and few have leachate collection systems; studies have estimated that about 75 percent of all active and inactive sites leach. Unfortunately, there are no firm data on the total number of land disposal sites. Among existing estimates are these:

  -- A 1978 Waste Age survey identified approximately 15,000 active municipal landfills, of which only 35 percent were in compliance with State regulations.

  -- An EPA-funded report estimated the number of active industrial landfills to be 75,700 and and number of abandoned sites to be possibly as high as 100,000.

  -- Another EPA-funded report estimated that 19,400 sites, either landfills or lagoons, are needed to handle the current stream of hazardous waste and that 50,600 active and inactive sites contain potentially dangerous amounts of hazardous waste.

- The Surface Impoundment Assessment, funded by EPA and conducted by the States, identified 25,800 industrial sites and 181,000 impoundments. Because of the hazardous nature of much waste placed in industrial impoundments, states were asked to perform detailed assessments of industrial sites. Preliminary analyses of 8,200 industrial sites indicated the following:

  -- Most--70 percent--are unlined and possibly allow contaminants to enter the ground.

  -- Moreover, 10 percent are not only unlined, but also overlie usable aquifers and are on permeable soil; of these, one-third are within one mile of a water supply well.

  -- About 35 percent hold liquid wastes that may contain hazardous constituents.

  -- Only 5 percent are known to be monitored.

Contamination by On-lot Disposal Systems, Radioactive Disposal Sites and Buried Storage Tanks

Domestic on-lot disposal systems also represent threats to public health when improperly designed, operated or maintained. The primary concern in their case is the large number of sites and the potential for bacteriological and chemical contamination. Recent studies indicate that significant amounts of organic contaminants have been introduced into ground water through septic systems. Buried storage tanks are also of concern because of the nature of such contaminants (primarily gasoline) and the significant number of such sites in areas of high population density.

Radioactivity waste disposal sites pose a potential long-term threat to public health. Some ground-water contamination has been associated with leakage from the temporary storage areas in which wastes are held prior to transfer to permanent sites. Radioactivity is also associated with the wastes produced by sources such as uranium mines and mills and by the mining and milling of phosphates and metallic ores such as copper.

Other Threats

Some sources of contamination endanger public health by introducing into ground water potentially hazardous materials that would not normally be detected by a user. Other forms of contamination make ground water more obviously unusable. For example, salt water encroachment (often caused by overpumpage of adjacent fresh water), brine injection wells, and highway deicing salts may cause localized problems in the continued use of ground water both as drinking water and for irrigation. Abandoned wells can create problems, too, if constructed so that water in poor-quality aquifers can enter aquifers of good quality through uncemented well bores. The use of pesticides in agriculture is also emerging as a problem in some areas. While artificial recharge is considered a viable technique in some parts of the country for conserving water that would otherwise be wasted through evaporation or runoff, there is concern that recharge of ground water by some types of water (for example, treated industrial or municipal wastewater) could preclude its future use. Recharging using municipal wastewater must be carefully controlled to prevent bacteriological problems that might preclude domestic use.

Ground-water contamination implies more than such threats to public health. It also involves economic and environmental costs. Water quality changes induced by major ground-water withdrawals for agricultural activities, for example, can result in reductions in net economic benefit. For instance, irrigation can lead to an increase in the salinity of ground water which in turn can lower crop yields. Similarly caused changes in ground-water quality can also increase the costs for users who need to treat the water to enable continued use.

Activities related to mining waste disposal and acid mine drainage pose a threat to ecosystems as well as to certain uses of ground water. For instance, mine drainage and waste piles can result in excessive heavy metals in ground water that would preclude its use as drinking water without major treatment.

Contamination by Organic Chemicals

Drinking water drawn from the ground has generally been viewed as a pristine resource, unspoiled by human activities. Recent information, however, has revealed that many ground waters are contaminated by organic chemicals. The data are particularly disturbing in that many of these chemicals are known or suspected carcinogens. Moreover, they have frequently been detected at levels that are orders of magnitude higher than those generally found in surface waters.

As a result of these discoveries, Federal and state agencies have increased their monitoring efforts and new data are being produced continually. Most of this monitoring is concentrated in areas where contamination is suspected, making it difficult to generalize about ground waters. However, it is clear that a widespread problem exists and that many more cases will come to light as more monitoring is done.

As a result of these monitoring efforts, at least 20 communities in Massachusetts have discovered their public water supplies to be severely contaminated with one or more synthetic organic compounds: 16 incidents have occurred in Connecticut, 25 in Pennsylvania, 22 in New York, and one or more in each of 20 other states. New Jersey and California have also detected large-scale contamination in ground water.

For example, a recent testing program conducted by Connecticut's Department of Health Services at the request of the State Legislature has detected a large number of wells contaminated with volatile organic chemicals. Initial results were reported on the basis of tests of the wells used by 78 of the 95 water systems in the state which serve populations of 1,000 or more. In that sample some quantity of volatile organic contaminants were detected in 87 percent of the wells tested. Of those, 23 wells serving 17 of these systems were found to contain chemical levels in excess of EPA's suggested no adverse response level.

In another example, the municipal landfill in Jackson Township, New Jersey, was licensed by the state to receive wastewater sludge and septic tank wastes, but it now appears that dumping of chemicals has also occurred at the site. As a result, approximately 100 drinking water wells surrounding the landfill have been closed because of organic chemical contamination. Analysis of water samples has shown the presence of chloroform (33 ug/l), methylene chloride (3,000 ug/l), benzene (330 ug/l), toluene (6,400 ug/l) trichloroethylene (1,000 ug/l), ethylbenzene (2,000 ug/l), and acetone (3,000 ug/l).

As of March 1980 over 8,000 chemical determinations for volatile organic compounds had been performed on well water by state agencies. While a large number of compounds have been detected in these and other analyses, chlorinated organic solvents have been found most frequently, sometimes at very high levels. Several of these solvents have been shown to cause cancer in laboratory animals.

Most frequently found was trichloroethylene, an industrial solvent and degreaser. This compound was found in one third of the samples tested, with concentrations as high as 35,000 ug/l. (This should not, however, be interpreted to mean that one-third of the nation's drinking water supplies contain measurable levels of trichloroethylene; the state monitoring was concentrated in areas where contamination was expected and a representative sample would undoubtedly show lower levels and lesser occurrence. Such data, however, are not yet available.)

Other volatile organics frequently found in ground water include tetrachloroethylene; 1,1,1-trichloroethane; 1,1-dichloroethane, and dichloroethylenes.

THE DIFFICULTIES OF GROUND WATER PROTECTION

Strategies to control ground-water contamination must take account of the major difference between ground water and surface water. Compared with surface water contamination, ground-water contamination is much

more difficult to detect in a timely manner and to clean up once discovered. In ground water, it is also harder to predict the path and rate of movement of certain constituents. Further, it is extremely difficult, if not impossible at our current state of knowledge, to analyze changes in ground-water quality as a result of a particular land-use activity. These difficulties are related to the physical characteristics of ground water, to the diversity of means by which it can be contaminated, and the characteristics of the aquifer and overlying geologic materials.

Slow Movement of Ground Water

Although some ground waters have very rapid rates of movement in the feet-per-hour range, such as through limestone, most have velocities in the feet-per-year range. The slow movement of ground water can create difficulties because large amounts of contaminating material can enter the ground water without detection. For instance, if a monitoring well is located at or near the point of use and the actual source of contamination is a long distance away, contamination could continue for many years before detection and take just as many years to pass the point of use.

Ground-water flow characteristics are usually predictable in that a plume of contamination is fairly narrow and will not permeate the entire aquifer. If a basin-wide monitoring program, however, relies on randomly selected wells, detecting contamination in a timely manner will be almost impossible unless a well happens by chance to be located immediately in the line of major flow from a contamination source. This fact has important consequences for the design of a monitoring program, as discussed below. Even more important, new management techniques will have to be developed to avoid serious public health risks which may occur as these plumes enter the area of influence of drinking water wells.

Monitoring Difficulties

There is currently no data base from which the magnitude of the ground-water contamination problem can be determined. The large amounts of data gathered by the states and the U.S. Geological Survey have generally not focused on the types of problems that have more recently become the object of concern, particularly hazardous waste disposal and contamination by synthetic organic chemicals. The data available are largely anecdotal in

nature; that is, based on investigation of particular instances of contamination. Therefore, it cannot be determined with confidence how representative these cases are. Increased attention to ground-water contamination problems is likely to lead to efforts to improve this data base and, to some extent, to redirection of current monitoring efforts.

Ground-water monitoring is much more expensive than surface water monitoring, since it is necessary to drill a well in order to monitor each observation or monitoring point. In addition, the design of a monitoring system should be tailored to the kind of contamination problem that is being studied.

For example, localized sources of pollution such as landfills and surface impoundments may produce plumes of contamination around the site. Because of the slow movement of ground water, these plumes will frequently be limited in size (although continually growing). Therefore, any monitoring plan using wells scattered over a large area is likely to miss most plumes, thus producing a misleading result. This suggests that the appropriate unit of sampling for such a plan is the potentially polluting site, rather than the aquifer. That is, monitoring wells should be located near the sites and positioned so that they can detect pollution if it is occurring.

Many such potentially polluting sites either currently have monitoring wells around them or will be required to drill monitoring wells by regulatory programs now being established. This will make it feasible to select a random sample of such sites and monitor the quality of ground water in their immediate vicinity. Such a survey would yield systematic and representative data which could validly be generalized to conclusions about the extent of pollution from such sources.

Area-wide sources like fertilizer use can affect large ground water areas and are more easily detected by the conventional aquifer surveys. Generally, basin-wide monitoring detects a problem only when contamination has reached a stage where water quality changes are regional in nature. This is especially true if the monitoring program relies on wells that are designed for water supply, particularly if they are of limited depth. Therefore, building monitoring networks to provide an accurate picture of changes in ground-water quality is expensive and difficult to accomplish. This is a fundamentally different problem from monitoring surface waters where access is seldom difficult.

Diversity of Sources of Contamination

Protecting ground water from pollution is further complicated by the varying nature of the sources of pollution. These sources can be classified according to industry involved, type of waste, volume of waste or regional distribution.

Localized sources, though numerous, are subject to control on a site-by-site basis. Generally, contamination from such sources occurs in a localized area around the site. Pollution from area-wide sources, such as agricultural practices and highway deicing, often covers a wide area and is less subject to site-specific controls. Controls may involve changes in operation (for example, a "best management practice" such as controlled use of fertilizer) rather than direct expenditures on control technology.

Restoration or Cleanup

If a large area of contamination is found, it may be extremely difficult and expensive to institute an aquifer clean-up program. While elimination of the original pollutant source material is essential and will be the purpose of Superfund efforts, cleanup of the ground water itself is difficult. This is because of problems in defining the area of contamination; because of the large amounts of water that have to be removed, treated, and returned to the aquifer; or because of the difficulty of changing hydraulic gradients to control the direction in which the unwanted contaminants are moving. In contrast, surface waters move quite rapidly and can flush an area clean in a relatively short time once the discharge of pollution has stopped.

EXISTING GROUND WATER PROTECTION EFFORTS

Numerous Federal laws deal in some way with ground-water management or protection, yet neither these laws nor existing state programs fully address the range of problems presented by ground-water pollution. They are a patchwork of efforts that fail to cover some of the most serious problems.

A brief summary of the major sources of ground-water contamination and the current approaches to their control are presented in Table III-1, page III-10. In most instances, for each major source of contamination, there is an individualized approach to control on the part of state, local, and federal agencies.

TABLE III-1

MAJOR SOURCES OF GROUND WATER CONTAMINATION AND CURRENT APPROACHES TO CONTROL

Sources of Contamination	Primary Basis of Current Control Efforts
Waste Disposal Sources	
Landfills, Dumps, and Surface Impoundments	Federal regulations and state delegation under RCRA.
Mining Wastes	Previously BMPs for active mines and little for abandoned mines, 1977 Surface Mining Act initiated permit and reclamation programs.
On-lot Waste Water Disposal Systems	Generally local or county control under state health regulations, with evaluation of alternatives under 208 funding.
Radioactive Wastes	NRC authority, sometimes delegated to states.
Sludge Management via Land Spreading	BMPs developed at federal level
Underground Injection Wells	New UIC program of federal standards and state enforcement under the Safe Drinking Water Act
Land Treatment of Municipal Waste Water	Step 1 for new POTW construction
Non-Disposal Sources	
Abandoned Wells	Limited state programs, some expansion of program under UIC and SWDA emergency actions
Accidental Spills	Federal advice available, sometimes assistance; SDWA; RCRA and Superfund (If enacted) will extend authorities and funding
Agriculture Practices	Primarily recommended BMPs, with selected regulations under FIFRA and CWA
Artificial Recharge	BMPs under development by EPA and selected cities
Highway De-icing Compounds	BMPs at state levels
Petroleum Exploration and Development	State programs in past, now UIC and RCRA add federal standards for injection wells and lagoons.
Underground Storage Tanks and Pipelines	Some local or state standards for construction, few inspection programs
Depletion	
Increased Salinity	State and local efforts
Salt Water Encroachment	State and local efforts

Source: Planning Workshops to Develop Recommendations for a Ground Water Protection Strategy, Table II-1.

Federal Efforts

EPA has recently turned its attention to ground water protection. Despite several specific references to ground water in the Clean Water Act (CWA), Congress did not explicity confer federally enforceable authority in that Act. Courts narrowly interpreted the Act's ground-water provisions, and the Agency itself, for many reasons--lack of resources and pressures to deal with surface waters among them--deferred action that would protect ground waters. Ironically, in some situations Agency actions resulted in increases in ground-water pollution by diverting pollution from surface waters to the ground.

In recent years some provisions of the Clean Water Act have been used to increase ground water protection. Most notable is the Water Quality Management Program required by Section 208 of the Clean Water Act. It served as the catalyst that enabled many states to develop ground water management programs and particularly to experiment with innovative ways of dealing with non-point source problems. Grants to the states for pollution control programs provided under Section 106 of the CWA, and the creation of coordination mechanisms such as State EPA Agreements, have also strengthened state abilities in ground water protection.

Nonetheless the federally enforceable elements of the Clean Water Act have not been directed to ground water protection. For example, EPA has construed Section 303 (Water Quality Standards) to apply to ground water only in unique and narrow circumstances. Accordingly, it has not developed a program of nationally consistent ground-water quality standards. Further, there are conflicting judicial opinions concerning EPA's authority to issue NPDES permits related to ground water protection.

Several provisions of the Safe Drinking Water Act (SDWA) relate to ground water protection. One of these creates the Underground Injection Control program which establishes minimum standards for injection well design and operation and state program requirements. The Act provides for regulation of injection wells by permit or by rule. EPA regulations specify procedural and technical requirements for the program, including construction, operating, and monitoring requirements for injection wells. The Act envisions state assumption of the primary responsibility for enforcement of the standards. A limiting factor with respect to this program is that it is intended to protect ground waters that are current or potential sources of drinking water, thus only restricting pollution in single-use sources and disregarding other uses and ecological needs.

Another provision of the SDWA is the Sole-Source Aquifer Protection Program (Section 1424(e)) which provides a mechanism for state, local, or regional agencies to petition EPA to protect recharge zones or special aquifers by designating them sole-source aquifers. A limiting factor of this provision is that it protects only recharge zones from the federally funded projects that might contaminate them. Non-federally funded projects are not regulated. Despite this and other limitations, it is the only EPA program that uses recharge zone protection as a ground water management tool.

The Resource Conservation and Recovery Act (RCRA) of 1976 provides for control of the land disposal of municipal waste and the generation, treatment, storage, and disposal of hazardous waste and provides authority to act against imminent hazards. EPA regulations provide for a manifest system to track hazardous wastes from the point of generation to the ultimate disposal sites. This Act also provides for Federal standards for disposal of nonhazardous waste, but these standards are not federally enforceable. Again, this Act provides for delegation of enforcement responsibility to the states.

The newly launched UIC and RCRA programs provide significant funds for state grants, which may greatly improve the ability of the states to fund ground water protection programs.

The Surface Mining Control and Reclamation Act of 1977 under the administration of the Department of the Interior provide authority to control surface mine pollution; protection of ground waters is explicitly included. The Uranium Mill Tailings Radiation Control Act of 1978 mandates EPA to establish radiation standards for uranium mill tailings and the Nuclear Regulatory Commission to implement and enforce the standards.

Other EPA laws such as the Toxic Substances Control Act (TSCA) and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFPA) have the clear potential in certain circumstances to restrict the use of or ban substances that are of particular danger. Finally, EPA has proposed Superfund legislation which is now under consideration of the Congress. This authority, if passed, will support the cleanup of abandoned hazardous waste sites which may be contaminating ground water.

Thus, Federal programs provide for explicit, well-developed regulatory approaches for some threats to ground-water quality and devote only incidental attention

to others. Hazardous waste disposal and underground injection are well covered by mandatory federal programs that are now entering the implementing phase. Federally funded projects in the recharge zones of designated sole-source aquifers are regulated, but other projects in those areas are not. Potential ground water impacts of surface mining and the uranium fuel cycle are covered by programs designated to deal with those activities comprehensively. EPA has provided Section 208 funds to states to develop ground-water management programs.

State Efforts

The state governments have been faced with a difficult challenge for many years in the area of ground-water quality management. The combination of the technical complexity of the problem, the competition within state goverments for administrative and financial resources, and the lack of any central coordinating federal program have all made significant progress in the area difficult. Some states have been able to achieve notable progress, while others have not been able to win adequate support to make ground water protection a high priority.

Approximately 60 percent of the states rely on general laws as the basis for ground water protection. Laws specific to particular sources of ground-water pollution or related activities exist only sporadically, are often not explicitly designed to protect ground-water quality, and commonly include grandfather clauses that exempt existing pollution sources. Laws that do exist to protect ground water from specific sources of pollution are not generally applied in a coordinated program aimed at ground water protection but implemented by diverse agencies whose primary responsibilities are not directed at ground water protection.

State programs to protect ground water are usually carried out through several state agencies. Typically, a public health agency has (or shares) authority over on-lot wastewater treatment. An environmental agency will have authority over most ground-water pollution sources, although in several states the authority for individual sources of contamination belongs to more than one agency (that is, oil- and gas-related issues are under a separate authority from industrial waste sites). A third agency may have responsibility for ground-water quantity issues. In addition to the state agencies possessing regulatory authority, other agencies such as a state geological survey or the state soil conservationist are involved in data collection or in providing technical assistance.

There are attempts in several states to coordinate efforts through multi-agency advisory committees or task forces. However, many relationships that exist among the personnel of various state agencies are informal and subject to the traditional problems of turf, personalities, and available resources.

State staffing and budgetary limitations will, for the most part, determine the ultimate form and organization of ground water protection efforts. It appears that no state has the resources or funding it needs. For example, several states have septic tank regulations or regulations on oil-well drilling but insufficient staff to enforce them adequately. A broad extrapolation from data collected regarding the number of work-years currently involved in state ground water protection programs indicates that about 525 work-years of professional/technical effort are expended each year by all states.

A state's efforts in the protection of its ground water and its commitment in resources is a function of whether it perceives a problem. The level of concern varies tremendously between states. In some instances a state may not, at this time, be a heavy ground-water user and may be complacent concerning the issues. Other states--New Jersey and Washington, for example--are developing fairly large staffs devoted to ground-water issues and appear to be in the forefront in developing innovative approaches to ground water protection.

In order to round out the general information needed to give a reasonable picture of existing state ground water protection programs, ground-water standards were selected as one barometer of state programs. Five states have standards in effect, six are currently reviewing or processing proposed standards, and another seven are currently involved in drafting ground-water quality standards. Thus, nearly 40 percent of all states are either taking or have taken steps to develop specific standards to protect ground-water quality. However, ground-water standards may be very different from state to state, with each state emphasizing the parameters and levels needed to ensure its own protection.

In addition, major sources of ground-water pollution vary from state to state. For example, in Washington and Vermont, on-lot wastewater treatment is considered the most severe problem, while in New Jersey, surface impoundments that are leaking toxic wastes are the greatest source of pollution. Programs also vary substantially among states. In regulating septic tanks, some states require permits, some inspect construction and others regulate system installers. Attitudes toward land-use controls also vary. In Washington, for example, sensitive aquifers and recharge areas have been identified, and

courts have held the right to deny permits for septic tanks on these aquifers based upon ground-water contamination.

Information essential to proper management of the ground-water resources is also lacking in many states. In a preliminary inventory, six states were identified as having substantial knowledge of their ground-water resources. Nine states are in the process of inventorying. Five states have a particular inventory and 27 states have no systematic inventory.

In addition, there are growing political pressures in most states to limit expanding state bureaucracies. There is a trend toward establishing limits on budget and personnel increases, particularly in areas supported by Federal funds.

Effect of Federal Programs

A number of Federal programs are being delegated to the states for management over the next two to five years. Some of these deal directly with ground-water management--the UIC and RCRA programs, for example. Other programs much more indirectly related include the grants program for the construction of wastewater treatment plants. The delegation of existing environmental programs has tremendous implications for state governments. The principal impacts will be to impose minimum Federal standards as established in the statutes and to promote significant new levels of Federal grant assistance.

Conclusion

Thus it is clear that there is a growing interest in and concern about ground-water management on the part of the states. Many state agencies are involved in ground water protection. Existing resources, data bases, and available expertise are extremely limited. As a result, there will be fierce competition for resources in state governments and a major management challenge facing state officials.

PART TWO: STRATEGY

IV. INTRODUCTION TO THE STRATEGY

EPA is proposing a ground water protection strategy in recognition of the need to begin a preventive program to protect the quality of the Nation's ground water in the future and to manage the growing number of instances of significant contamination currently being discovered.

The problem is undeniably huge, considering the extent and importance of our ground-water resources and the many widely occurring threats to its safety. The problem is also unexpected; it is contrary to past conventional wisdom that nature protects our underground waters. Control measures are few because few were thought to be necessary. And the problem is complex: detecting and cleaning up contamination are difficult and costly operations.

The prevention of ground-water contamination is a critical national imperative. Yet waste disposal and other industrial and agricultural activities which threaten ground-water quality cannot be halted altogether. More instances of contamination will be found. The solution must be a realistic blend of protective measures and practical alternatives to current practices.

Citizens expect Federal, state, and local governments to take prompt action in defense of so great a public interest. Yet in general, public institutions are not now equipped to respond efficiently and effectively. Many agencies have authority bearing on one or another aspect of the problem but no agency at any level has overall responsibility. Nor is there an existing framework through which various agencies and levels of government can coordinate their activities. Therefore, setting priorities, taking consistent appropriate action, and even assessing the dimensions of the problem are extremely difficult. Even making full use of existing authorities and regulatory tools is often beyond the capabilities of the agencies concerned.

What this strategy proposes, then, is to construct a framework for ground water protection which:

- facilitates the development of institutional capabilities at the Federal/state levels;
- enables consistent ground-water policies and priorities to be set;
- expedites the gathering of data, technological information, and expertise;

- focuses attention and action on high priority problems; and

- promotes longer range planning and identification of more comprehensive future actions.

The proposed ground water protection strategy can provide such a framework. With the development of companion state ground water protection strategies, State and local governments can collaborate with each other and with EPA, all using their existing authorities and resources to full advantage. Classification of ground waters can begin, using consistent criteria to identify high priority ground-water resources and potential siting locations. Research and development as well as technical information and assistance programs can be intelligently and expeditiously launched. Other high priority problems can be pin-pointed and we can begin to address them.

Obviously the key to the strategy's success is a cooperative relationship among all levels of government in which we agree to work together, directing existing authorities and resources toward a common goal, toward agreed-upon urgent priority problems, and toward the development of a sound and workable long-range effort to protect the Nation's ground water. Out of our initial experience in implementing current programs will come a better understanding of the future magnitude of this problem and how best to limit future contamination as well as how to deal immediately with problems as they are discovered. As this experience is gained and assessed the need for additional Federal legislation will be considered in the future.

V. ASSUMPTIONS

The proposed ground water protection strategy is based upon a number of premises or assumptions. While these are often unstated, it is important to make them explicit so there can be a common understanding and meaningful discussion of the proposed strategy.

The major working assumptions upon which the proposed ground water protection strategy is based are:

- Ground-water threats will not be controlled quickly; the effort to develop a comprehensive protection program will be a long-term one spanning many years. Hence, the planning horizons must be long term.

- Coordination at all levels of government (Federal, State, regional, and local) is essential to the success of the ground water protection strategy because the problem is so complex and institutions dealing with activities affecting ground water are so numerous.

- The strategy will not be able to identify all long-term priorities and policies; it provides a framework and a process for initiating programs now and for making other decisions at the appropriate time in the future (i.e., there will never be a time when all the answers are available and the ultimate ground water strategy can be completely defined).

- The quantity and quality of ground water are so inextricably linked that any efforts to protect or enhance quality will have to be coordinated with the activities of the states and other Federal agencies in managing the quantity of ground water use. Ground-water management efforts must also be coordinated with surface water quality management programs.

- Pending the adoption of a ground water classification system, all ground water currently of drinking water quality will be presumed to be a drinking water source and provided protection to ensure that its utility for this purpose is not impaired.

- Setting up a framework of institutional relationships and programs for further ground water protection will take time and information. To support the process, a priority must be assigned to gathering the needed scientific and engineering knowledge on ground-water contamination, assessment, enhancement, and protection.

- State and Federal resources available for ground-water issues are limited. It is important to phase a strategy over time and to encourage the application of resources to the highest priority ground-water needs in each state, with respect to vulnerable and needed ground waters, toxicity of contaminants, severity of risk from polluting activities, and susceptibility to management action.

- The strategy should encourage new and innovative approaches to ground water protection through, for example, process engineering changes to reduce pollutant volumes, product substitution, increased recycling, and treatment techniques prior to disposal. It should also encourage innovative legal and institutional approaches to ground-water quality management.

- Consistency among states is desirable in their approach to ground water protection, including terminology and definitions, use classifications categories, and in many technical and administrative areas as well. It is also expected that the programs within states will within certain circumstances accommodate local conditions and priorities. Nevertheless, it is assumed that this approach will facilitate responsible negotiations between states to assure consistent and appropriate classifications of ground waters crossing state boundaries.

- No major new Federal legislation (with the exception of Superfund) is anticipated at this time in the ground water area. Existing authorities appear adequate to initiate the strategy and to begin to provide increased protection of ground water. Legislative changes may ultimately be necessary, but sound and specific proposals can best be determined after more data and experience have been gained.

VI. GOAL AND OBJECTIVES

GOAL

The proposed goal for the ground water protection strategy is:

> "It shall be the national goal to assess, protect and enhance the quality of ground waters to the levels necessary for current and projected future uses and for the protection of the public health and significant ecological systems."

The term "goal" is used here in the sense of a mission or an overall statement of purpose. It is intended to be an achievable goal, at least in the long run.

The goal recognizes that not all ground water is of the same value. For example, some ground water is of extremely high value because it serves a very critical human use or ecological function; some is of very high quality or extremely scarce. Such ground waters should be accorded the most stringent protection and levels of control.

The goal for this ground-water strategy must be both visionary and realistic. On the one hand, the goal must be a commitment to protect this basic natural resource for future generations. At the same time, it must be sensitive to the competing interests that will be affected: state, national, corporate and individual. There is always some cost, economic or other, to protecting any natural resource. There is also a social cost, perhaps long term, to not protecting such a basic natural resource as ground water. This goal attempts to reasonably take into account these competing interests.

This goal is primarily preventive, rather than curative. The long-term focus of this strategy is to prevent ground-water contamination before it occurs rather than to focus on after-the-fact cleanup efforts. In the short term, however, ground-water quality problems must be remedied as they continue to be discovered.

This goal also provides flexibility to accommodate state and local conditions affecting ground water. Incorporating as it does the assessment of natural geologic and hydrologic characteristics of areas as well as uses of ground water, the goal encourages actions which are tailored to state and local conditions.

"Assess"

The goal contains three active verbs. The first of these is "to assess" the quality of ground water in order to be able to protect and enhance it to the appropriate levels.

In this context, to assess the ground water does not mean that full scale inventorying and monitoring is needed before dealing with known problems. It does imply taking stock of existing information and where needed gathering new data, in order to reach sound judgments on the appropriate levels of protection for individual ground waters.

"Protect"

The second action word in the goal is "to protect" the quality of ground waters.

The proposed goal embodies a protective presumption that the quality of ground waters ought to be preserved and protected for ourselves and for future generations. It also recognizes, however, that appropriate degrees or levels of protection in certain circumstances may vary from place to place depending upon local conditions and the use for which the water will be needed.

"Enhance"

The third action word in the goal is "to enhance" the quality of ground water. This is expected to be utilized in cases where some degradation of quality has occurred and where restoration efforts are warranted and feasible. This will occur in three situations: first, where public health or the environment is significantly threatened; second, where the ground waters are of importance for certain uses in an area; and third, where the contamination can be practically reversed.

Enhancement is a supplement to the main focus of the strategy, which is preventive in nature. These after-the-fact corrective actions are important but deal only with those contamination problems which already exist and those which occur accidentally in the future.

Current and Projected Future Uses

This goal is keyed to protecting ground water in places and to quality levels according to present and future use. This is very significant since different uses of water require varying levels of water quality.

Naturally, current uses of ground water will receive very high priority. Forecasting is needed to predict future water uses; the goal also suggests that ground-water quality be protected to levels consistent with those anticipated uses. Projections of future ground-water use will necessarily consider population projections, land-use patterns, industrial expansion plans, and agricultural needs, as well as the availability of alternative water supplies.

The goal also implies that explicit decisions will have to be made between ground water protection and other competing activities. It acknowledges that certain industrial and other activities may necessarily be of higher priority than ground water protection in some areas and, though they may pollute aquifers, should be continued or cannot reasonably be discontinued. Frequently cited activities which may conflict with ground water protection are fuel extraction and processing, agricultural practices related to irrigation return flow and fertilizer use, waste disposal, and highway deicing. Such decisions clearly should be made in a public forum with adequate programs for public participation. These should assure consideration of the long-term water needs of an area and require appropriate controls on those activities which are allowed to limit and control the spread of unwanted ground-water contamination into areas where it will cause problems. Setting a priority for ground water use other than for drinking, for example, does not mean that mitigating measures need not be instituted to minimize the effect of these competing activities. Nor does it mean that EPA would take less stringent action when an imminent hazard threatens.

Protection of the Public Health and Significant Ecological Systems

While the strategy focuses on protection for current and projected future uses, an overriding concern must be the protection of the public health. Where limited degradation will occur of necessity, provisions must be made to assure protection of the public health. This principle takes on special importance when one considers that ground waters often remain underground for hundreds of years; contaminants deposited today in a given location may emerge miles away in the twenty-third century or beyond.

Where the migration of contaminants from past activities threatens ecological systems, suitable action should also be taken. Examples of this would be the discharge of toxic contaminants in ground water into wetlands which would pose major risks to the related sensitive ecological systems.

OBJECTIVES

The goal must be translated into some specific objectives so that progress toward the goal can be made across a broad front and measured over time. These objectives can also serve as guides to a phased implementation since it will take years to fully implement the strategy.

The objectives of the ground water protection strategy are:

By 1985

- To initiate ground water protection strategies in all states, aimed at meeting the goal and and the long-term objectives and to develop the basic institutional capacities (resources, personnel, etc.) at Federal, State and local levels.

- To implement fully the currently enacted Federal regulatory programs which affect ground water (e.g., Resource Conservation and Recovery Act, Underground Injection Control Programs, and Surface Mining Reclamation Act).

- To launch technical and administrative efforts to evaluate ground-water quality, to ameliorate the most hazardous conditions discovered, and to develop and implement methods of managing newly discovered plumes of ground-water contamination.

- To provide a process whereby State and local governments and the public can, in specific situations, with adequate public health and environmental protection, set priorities among competing activities which may use or contaminate ground water.

By 1990

- To ensure that appropriate levels of protection are provided for the ground water resources in each state and that each state has a complete program fully implemented to manage all ground water.

VII. MANAGEMENT APPROACH

INTRODUCTION

The approach to managing ground water protection which is envisioned in this strategy is an institution-building and priority-setting process. It provides the basis for deciding which ground waters require the greatest levels of protection, which sources of contamination to act against first, and what general roles ought to be taken by Federal and State governments and others in developing and implementing such programs. This management approach has direct implications for the next chapter on technical requirements.

KEY ELEMENTS IN THE MANAGEMENT APPROACH

There are four key elements in the proposed management approach to ground water quality protection. These are summarized briefly below:

1. State Ground Water Protection Strategies. These strategies, developed at the state level, should identify how the national goal will be met through specific regulatory and other program actions at the state and local levels, including alternative approaches such as economic incentives.

2. Ground Water Classification. The primary basis for establishing priorities on ground water protection would be the classification of ground waters according to the differing degrees of protection warranted. Where ground water is of drinking water quality or better, there will be a presumption that it will be classified and protected as such, unless a lower classification is justified by a thorough analysis of the impact of such action on ground-water quality in the affected areas, the present and projected future drinking water needs and availability, and a full public consideration of competing uses.

3. Minimum National Requirements for Selected High Priority Problems. There are some problems which, on a national scale, are so severe and complex that they should be assessed on a national basis. Where national action appears to be appropriate, EPA in consultation with the states and other affected parties would develop regulations or legislative proposals.

4. EPA Administrative Actions. An important element of this approach to ground water protection is the coordination of existing EPA and other Federal programs providing increased guidance and support to the states in carrying out their ground water protection strategies and increased research on ground water.

Further elaboration of the elements described above is presented in the following sections.

STATE GROUND WATER PROTECTION STRATEGIES

The development of ground water protection strategies by the states is a central element of the proposed ground water strategy. These strategies should establish the framework for planning, implementation, and enforcement activities at the state and local levels and should aid immeasurably in coordinating state efforts with those at the Federal level. Under this approach the states will continue their historical role as the primary authority over issues affecting both the use and quality of ground water within the framework of existing legislation.

EPA envisions a three-phase approach to developing state strategies. First, EPA will formulate and issue guidance for development of the strategies with the full participation of state and other interested groups. Second, States would prepare the strategies with the participation of affected local governments, the public, business, and special interest groups. Third, these strategies would be incorporated into the State/EPA Agreements (SEAs), with EPA reviewing the strategies and approving those portions dealing directly with the implementation of programs required under Federal legislation. EPA would encourage States to use these strategies as a vehicle for comprehensive ground water protection that goes beyond federally mandated programs to address such problems as highway deicing, underground storage tanks, agricultural practices and other local practices.

Content of Strategies

The first step in the state strategy development process will be the preparation of guidance on the recommended content of ground water protection strategies. The following are examples of what would be expected in most state strategies:

- A goal and objectives consistent with those stated above and reflecting state and local conditions.

- A ground-water classification system consistent with a national set of criteria designations and other definitions.

- Mechanisms for coordinating existing State programs as well as Federal programs administered by the states related to ground water protection, including provisions for dealing with instances of ground-water contamination as they are discovered, especially to protect drinking water sources that may be threatened by the movement of these plumes of contamination.

- The state approach to controlling and integrating the control of non-federally regulated sources of ground-water contamination.

- The interrelationship of each state strategy to existing state and Federal programs affecting ground water (e.g., state programs related to ground-water quantity and allocation issues).

- How the state would negotiate with neighboring states to assure consistent classification and management of ground waters crossing state boundaries.

- Identification of the need and plans for enabling legislation at the state level to enact and carry out the strategy encompassing all state ground-water protection efforts.

- How the state will enforce the program including administrative and legal authority.

- How the state will coordinate state and local activities to implement the strategy.

- A phased implementation plan (including institutional, legal, and fiscal components) and a schedule, with plans for reassessment.

- A public participation program which includes developing and changing the strategy, making ground-water classification decisions, and setting technical requirements.

Implementing Actions

The EPA will assist states in preparing these strategies by, for example, providing guidance, technical assistance on specific problem areas and facilitating the exchange of information and experience among the states as they expand their ground water protection programs.

In addition, EPA will promote the development of state ground water protection strategies with interested states through the existing State/EPA Agreements (SEAs). Funding for such activities will, to the extent feasible, be made available from existing programs such as Section 208 (Clean Water Act), RCRA, and UIC.

EPA will provide additional support by better coordination and focusing of its own program efforts: construction grants, TSCA, FIFRA, RCRA and UIC.

GROUND WATER CLASSIFICATION

The development and implementation of a ground-water classification system is a second major element of this strategy. Its principal purpose is to provide for different levels of protection to ground water depending upon a number of factors. The classification process should help differentiate the high priority ground-water areas for high levels of protection and for first attention and investment, as well as identify those areas that are least environmentally sensitive for siting of new waste disposal facilities and other potential contaminating activity. This approach recognizes that not all aquifers have natural yields of the highest quality water and that all uses do not require the same level of quality.

The two sections below elaborate on the classification approach. The first describes one way the classification system may be developed and what factors may be considered in its establishment. The second describes how this system might be developed and implemented.

Classification System Development

EPA will develop a set of ground-water classes after substantial participation and consultation with state and local governments and other interested groups. The classification categories will be based on present or projected future uses and will include consideration of the quality of the ground water, its yield, its vulnerability and its value relative to alternative sources of water supply in an area. If, for example, a particular ground water is of marginal quality or good quality but low yield in an area richly endowed with high quality surface waters, then the ground water may not

necessarily be classified as a drinking water source if it is unlikely to ever be used for that purpose, if contamination can be limited to avoid threatening adjacent needed ground water resources and if the need for a competing use can be clearly established. On the other hand, that same source might be classified as a future drinking water source in the arid West where alternative supplies are not so plentiful.

The following tentative outline of such a classification system illustrates how it could be structured and how it would provide for three levels of ground water protection.

Definition of current and projected future use - First, perhaps as many as seven ground water use categories might be identified. These could include:

- Highly valuable drinking water, (sole source or pristine)
- Drinking water, with minimal treatment
- Drinking water, with extensive treatment
- Agriculture uses (irrigation, livestock)
- Industrial uses (cooling, process water)
- Mining and energy development
- Limited waste disposal

While the dominant factor upon which the classification system will be based is a judgment regarding the present and projected future uses of each ground-water supply, the definition of ground-water uses will also include the yield, natural quality of the ground water, and the availability of alternative sources of water. This will provide flexibility, for example, to rank a given ground water of marginal or low quality in a high category if it is the only available drinking water in an area to protect it to the greatest possible degree.

Conversely, because it may often be exceedingly difficult and expensive to clean up ground water once it is contaminated, a decision to classify ground water now suitable for drinking for a less protective use can have far-reaching and in some cases devastating consequences. Consistent with the strategy's goal to protect public health, any decision which may curtail future supplies of drinking water should be made only after a thorough analysis of the availability of other drinking water supplies and full public consideration of the social and economic trade-offs involved.

The classification process developed as a part of this strategy would therefore begin with the assumption that all ground water now suitable for drinking water (whether or not it is currently being used for drinking) must be presumed to have a "projected future use" as a drinking water supply and should be protected to levels consistent with that use.

As a state adopts a classification system and proceeds to identify and classify areas within the state for uses at levels lower than drinking such as agriculture, industrial development, energy production or limited waste disposal, the steps that should be taken prior to that decision should include:

- o a full assessment of future drinking water needs
- o a full assessment of quantity and quality of available drinking water supplies
- o a demonstration that any loss of potential drinking water supply will not be greater than that needed for future purposes.
- o adequate protection for significant ecological systems and public health
- o collection and analysis of appropriate related data on the ground water and the effect of the uses contemplated
- o development of control requirements for the non-federally regulated uses contemplated
- o full and formal public review

Such judgments will be especially important with regard to uses such as energy development or limited waste disposal which may preclude any future use of the ground water for other purposes.

Vulnerability - The second major factor determining the level of control needed is the degree of natural protection afforded by local hydrological and geological conditions. For ground water of given use classification, for example, drinking water, more control would be required in an area of sandy soil which affords little natural protection than in an area which already provides significant protection from contamination. Also, ground water is vulnerable to contamination from an overlying or underlying aquifer if the confining stratum between them is fractured and allows water to flow from one to the other. Levels of protection therefore could vary both as a function of the use classification and the natural protection in an area. Each type of contaminating activity would be controlled differently under one level of protection versus another.

Levels of Control - A three-tiered system is envisioned, the first generally includes ground water which serves a highly valuable human use or ecological function warranting the most stringent levels of control particularly to protect the recharge areas. This class could also include waters of lower quality but extremely high value such as very scarce waters essential for drinking purposes in arid areas, or ground waters traditionally used for drinking purposes in densely populated areas, which were becoming contaminated and for which extremely high levels of control were deemed appropriate to assure continued use for drinking purposes.

The second would provide levels of protection typically required to ensure a level of ground-water quality associated with use as a drinking water source. The assumption is that the majority of fresh ground water would be found in this class.

The third class would cover areas which provide the best opportunity for mitigating the adverse effects of necessary waste disposal or for which competing uses such energy production, agriculture or industrial use are determined to be necessary and appropriate. Here limited and defined contamination would be allowed for some but not all types of contaminants. It is expected that the number of areas falling into the third tier would be relatively small, decided through an open public process and limited in such a way as to prevent "pollution havens."

Classification of ground waters into any of the classes would in no way preclude or limit the EPA or a state from bringing an "imminent hazard" action if and when migration of contaminants poses a significant threat to the public health or the environment as defined under any of its statutes.

These three levels of requirements would be specified for various major polluting activities and for specific high priority contaminants. In cases of federally mandated programs or authorities, the Federal government would specify the requirements necessary for each of these levels. Where there are not Federal programs, the states would set control requirements for each level which are appropriate for protecting the state's ground-water resources. In such cases, the Federal role would be one of providing assistance by suggesting advisory or model control approaches such as best management practices (BMPs).

As an illustration, examples of the three levels of technical requirement which might be set by state and Federal governments include the following:

- Level 1 protection: could include a ban on facilities dealing with highly toxic or hazardous wastes or establish the highest level of control requirements; stringent limits for areawide activities such as new

septic systems; bans or restrictions on certain types of industrial development; a prohibition of certain energy development or other activities which significantly affect the ground water; and the highest priority to enforcement against existing sites which are polluting.

- Level 2 protection: could consist of limited siting for new facilities dealing with toxic or hazardous substances with strict technical and monitoring requirements; strict technical requirements and monitoring for existing sites; for areawide sources of contamination less strict siting and design standards such as for septic systems; and best management practices (BMPs) for other areawide activities such as agriculture and construction.

- Level 3 protection: would allow limited siting of facilities involving toxic or hazardous substances with less stringent technical requirements than above; it would include less strict BMPs for areawide sources such as agriculture; non-hazardous waste disposal and other contaminating activities would be subject to BMPs, and monitoring requirements would protect the public health and control serious threats to the environment for such activities as industrial water use, waste disposal operations and energy development. This tier would offer fewer controls on a facility, for example, but far greater attention to assuring that any resulting pollution is kept from migrating from the designated site through more stringent monitoring requirements.

Federal and State responsibilities -- This strategy envisions that the EPA and states would have quite different roles in developing and implementing a classification system. Since it is important to have a reasonable degree of consistency nationwide in the definition and categories used for these classification systems, EPA would take the lead in working with the states to develop a common system. This will facilitate cooperation in dealing with interstate issues and will provide a more understandable regulatory environment from state to state for businesses and individuals. Furthermore, a consistent classification framework is necessary for federally mandated programs to enable EPA to define regulatory requirements in a structure which each state can readily implement and in which EPA can ensure that the intent of its laws are fully carried out in all states. It would avoid situations which could cause major economic dislocations or promote "pollution havens" in localities more interested in development than in ground water.

If a state adopts the classification system, the state would make the decision in classifying individual ground waters into specific use categories and levels of protection. EPA would over-ride only where it affects program decisions under existing Federal legislation. Further, the states, except where provided for in Federal legislation, would make the permitting decisions or enforce the rules through which facilities or activities are kept in compliance with the related rules and regulations.

Classification System Implementation

The first step in the implementation of the classification system will be the development of criteria for classification categories. As the system is developed, these categories will be incorporated into existing ground water protection programs.

A guidance document would be prepared to describe the classification criteria and recommended procedures for state implementation. The document would also include information on classification models and other technical data of use to state officials in the classification process. Technical experts on ground water would be identified and made available as resources to the states. EPA will give particular emphasis to assuring that USGS and State Geological Surveys and other state agencies having responsibility for hydrogeological data collection are closely tied to this effort and that maximum use is made of their expertise and information resources.

Each state would adopt its own tailored application of the ground water classification system, responsive to the needs which the state perceives at the state and local levels yet consistent with Federal requirements for federally mandated programs. The classification system would be a key part of the state's ground water protection strategy and may require enabling state legislation prior to full implementation. State decisions of classification for particular ground waters would be made through a formal public process with participation of local government, affected business, and industry, and the public. Those who propose activities with the potential to contaminate ground water would be expected to bear the burden of proof that their activities would not jeopardize ground water for projected future uses. Once the classification system is in place it would be enforced through the usual permitting or rule-making process of the state or Federal government where appropriate. It is expected that state systems would vary, reflecting different values and situations.

Implementing Actions

Several EPA actions can be taken to support states in classifying their ground water. The first step is to work with states to develop the system. Secondly, EPA will make such classifications a grant-eligible activity under the State/EPA Agreements. Thirdly, EPA will work closely with USGS and other appropriate Federal agencies to ensure their full participation and contribution to this effort.

State officials will be encouraged to coordinate their classification efforts with other related programs such as land use planning, water supply needs assessments, state geological mapping and similar activities.

MINIMUM NATIONAL REQUIREMENTS FOR SELECTED HIGH PRIORITY PROBLEMS

Some problems affecting ground water are so serious, complex or ubiquitous that national action is warranted. Cases in which national action may be most effective could include situations, for example, where chemical substances, contamination pathways, and treatment processes are extremely complex and widespread; where special regulatory remedies such as product bans or use restrictions dictate unified actions; where interstate issues are significant, as in waste disposal; and where uniformity among states is clearly needed to avoid major economic dislocations and the establishment of de facto pollution havens.

EPA will also continue to make full use of its emergency provisions of RCRA (S 3008) and the SDWA (S 1431) to protect ground water. It is expected that the ground-water classification process and inventory efforts such as hazardous waste sites and surface impoundment assessment will identify even more highly dangerous situations which warrant action through these laws.

Another area for major EPA effort is the development of maximum contaminant levels and suggested no adverse risk levels for organics and other elements in drinking water. While these are not ground water standards, they are extremely useful in defining the health risk posed by contaminants in ground water likely to serve as sources of drinking water. They are of particular use to state officials in reacting quickly and knowledgeably to detected threats to drinking water sources. Increased research is being devoted to the development of risk levels in the area of pesticides as well.

National guidelines on how monitoring should be conducted and how results should be reported, stored and disseminated could also aid in improving the national data on ground water and the threats to it. Additionally, national surveys (such as the recently completed Surface Impoundment Assessment) will add to EPA's and the states' understanding of contaminant sources or of present ground-water quality. These data may identify pervasive contamination where national action could be effective. Such data may also aid states in detecting and dealing with plumes of contamination which may require state action. EPA, in conjunction with USGS and others, will devote substantially increased attention to this area.

Another area to which EPA will give major priority is the identification of procedures for dealing with instances of detected contamination. It will take time for state and EPA strategies to be fully developed and implemented. Meanwhile situations are already being discovered where serious ground-water contamination has occurred. There is a need to collect all that is known about tracking and managing underground plumes of contamination and to provide assistance and coordination to the states in that area. This will be a particularly difficult task due to the very slow movement of most ground water and long-term management problem posed by such instances.

EPA will also identify other high priority sources of contamination which deserve greater attention. One such source might be underground storage tanks. A fraction of these leak but they are subject to relatively limited technical requirements. EPA could conduct an assessment of this problem, work with industry to develop recommended design and installation standards, and work with state governments to develop better management practices or model state laws. Such model ground water programs are now being supported through the 208 program.

New Federal Legislation and Programs

At this time EPA is not proposing new Federal legislation. The immediate challenges seem to be ones of coordination, follow-through, and implementation.

As implementation of the existing programs is completed and more time and effort is devoted to new problems, the need for additional legislation and new programs for ground water protection may be considered.

Implementation Action

There are specific actions which the EPA is taking to begin implementing this aspect of the ground water protection effort, RCRA and UIC being of major importance. The inclusion of RCRA, for example, in the Consolidated Permits System will ensure that the effects on ground waters of surface impoundments which contain hazardous wastes will be addressed in a coordinated fashion.

EPA will also initiate work on recommended approaches to managing and tracking underground plumes of contamination, to high priority sources of contamination such as surface impoundments and gasoline storage tanks, and is increasing its efforts to provide information guidance and technical advice in the area of ground water monitoring.

Finally EPA expects to accelerate the development of additional drinking water standards for additional harmful contaminants such as synthetic chemicals which are reaching our drinking water and to provide significantly expanded advice on health risks posed by currently unregulated contaminants.

EPA ADMINISTRATIVE ACTIONS

Administrative actions by EPA will be important in supporting the states in ground water protection. The sections above have discussed actions which support the development of state ground water quality plans, which deal with ground water classification and in the establishment of minimum national requirements for selected high priority problems.

In addition to these specific actions described above, EPA will seek to coordinate its own regulatory and other programs related to ground water protection. These include RCRA, UIC, FIFRA, TSCA, and many sections of the CWA including Section 208 and the construction grants program. EPA will take specific steps to ensure that the approaches taken under these authorities are consistent with the ground water protection strategy.

EPA will also work with other Federal agencies such as the Nuclear Regulatory Commission, the U. S. Geological Survey, the Water Resources Council, the Council on Environmental Quality, and the Departments of Agriculture, Interior, Transportation, and Housing and Urban Development toward achieving the goals of this strategy. EPA will also encourage cooperation with the state strategies by all Federal facilities.

Steps will be taken at both EPA headquarters and the regions to assure coordinated implementation, using the SEA as a principle vehicle.

Research and Development

The Agency will reflect the choices in this strategy in its research and development activities. These needs will affect both the priority setting and selection of program elements for the R&D program. While specific decisions have yet to be made, the research areas which will be given high priority in support of this strategy include the following:

Methods development: The characterization of this nation's ground water is a critical element of the strategy. This will require definition beyond the traditional hydrogeologic parameters, including improved determination of acquifer boundaries and recharge zones and increased

capacity to conduct geophysical and hydrogeologic mapping for land use evaluations. EPA is now directing its efforts toward defining the nature of the subsurface environment in terms of its innate physical, chemical, and biological characteristics and developing a unified theory correlating these findings with contaminant transport.

A second area requiring considerable research is ground water modeling to predict the movements of contaminants in ground water systems. We need the capability to address economic and management problems as well as those in mass transport of organic and biological contaminants.

Major improvements are required in monitoring techniques including drilling, completing, and sampling monitoring wells. Research is needed on methods for monitoring leakage in the unsaturated zone and in determining the effects of waste disposal practices on ground water. In-situ monitoring, remote sensing, and the proper use of tracers are all areas needing extensive research. Finally surface methods must be developed to detect contamination and delineate the extent of contamination, thereby eliminating the need for exploratory drilling to find contamination, an extremely expensive practice.

Health effects research: Improved information on the long-term effects of organic contaminants is needed to support the development of standards for substances which are frequently found in ground water. Ultimately, this strategy contemplates the use of such standards for enforcement purposes as our knowledge in this area increases.

In the meantime, increased attention will be given to producing the science needed to support expanded drinking water standards and advisory information on unregulated contaminants of concern.

Transport and fate: Research will also be required to develop classes of contaminants and select an indicator substance for each of these classes in developing transport and transformation information. This is particularly true with respect to organics, bacteria and viruses, and to a lesser extent, metals. An important goal of this area of research is the development of indicators for monitoring.

Other areas of high research priority include:

- effects of water reuse on ground water;

- contamination potential, design standards, and treatment technologies for individual sources of contamination such as septic tanks and liners in landfills or lagoons; and

- aquifer rehabilitation, where extensive research is required in the physical or hydraulic isolation of waste sources and the treatment of contaminated ground water either in-situ or upon removal.

Other Research: Research will be needed in some less technical areas to support the strategy. One of these is in information transfer and data management. Systems must be developed for distributing existing and future technical information in practical and efficient ways.

Research is also needed on the institutional arrangements and legal issues which affect the strategy. Examination of economic incentives and other innovative approaches to ground water protection will be important.

Finally, experience in implementing the strategy will surely reveal other gaps in our knowledge and technology that will require research.

VIII. TECHNICAL REQUIREMENTS

The proposed strategy provides several types of technical requirements for use in controlling the many different types of problems affecting ground-water quality. Contaminant sources range from buried storage tanks to agricultural practices to waste disposal sites, and no one approach to technical requirements is appropriate for all.

Because the importance of different problems affecting ground water varies from state to state, it is expected that the relative emphasis on different types of technical requirements will also vary. Technical requirements will also vary, at least in degree if not in approach, for each ground water classification category. Requirements for the highest quality ground-water classes would, of course, be more stringent than those for classes where industrial development and even waste disposal will be located.

The mature state program envisioned as a result of this Strategy will protect ground-water quality to levels dictated by its value and its use. All ground water is not of infinite value. All uses do not require the same quality levels. The environmental impacts which can be tolerated in a particular aquifer, in keeping with its value and its use, will be limited by imposition of performance controls on facilities and practices which threaten ground water quality. Eventually, under a fully matured system, where water quality limits can be confidently established, a system to use value-related water quality standards could be considered. However, during the formative period in the near term, the proposed strategy must rely on technical requirements to achieve the protection appropriate to the aquifer.

The exact numerical or other standards which might be applied to any given activity are not to be defined at this time, not even in the development of the state ground water quality plans. These first steps are to define the approach to such requirements and to provide a framework and process for developing the specific requirements later during program implementation.

The Major Technical Approaches

There are four types of technical requirements which are expected to be used extensively under this strategy. These cover the range of problems which are the primary concern of the states under their ground-water quality plans and also cover the types of high priority problems which will be addressed by national actions.

These four major technical approaches are:

- Siting and Design Requirements. The designation of where and how certain facilities should be located is one of the most powerful tools for control of certain area-wide practices, such as septic systems and very toxic or hazardous sources of contamination. Siting standards or guidelines would be keyed to the type of ground water involved.

- Best Management Practices (BMPs). These "rules" that specify the best operating practices and recommended design and construction practices seem to provide the best vehicle for managing many area-wide activities which affect ground water. This approach to technical standards provides great flexibility to tailor requirements to individual, local situations.

- Technology-based or Effluent Standards. This approach typically specifies exact numeric limits for allowable levels of "discharge" to ground waters separately for each individual technology. This is generally best suited to industrial or other technological operations where process controls or changes can be designed to fit the needs of specific equipment, operating rates, and chemical constituents. Since "discharges" to ground water can be hard to quantify, this approach is sometimes implemented as a basis for design requirements rather than directly as an enforcement tool.

- Performance Standards. These standards specify performance levels which must be attained by certain types of activities or facilities and are not pegged to specific technologies. These provide the flexibility to encourage innovative technologies and other approaches to ground water protection.

Other Technical Approaches

Numerical ground water standards are appealing because they specify quality levels which can be measured to ensure that they have been attained. However, the technological bases for them are simply not ready to support specific standards. There is more to be done in the areas of monitoring, ground water modeling, fate and effect research, and other areas before ground-water quality standards can broadly serve as a basis for regulatory requirements at individual sites.

Technical approaches other than these four may be utilized by states and perhaps on some national programs, but are expected to be much less widely used than those above. In the long run new approaches may prove to be most effective, but for the first phases of ground water program implementation those above will be the mainstays of the program.

Economic incentives are desirable, but are not yet well defined. They are appealing because they provide local flexibility and lower societal costs. Consistent with the general Agency interest in the use of market mechanisms for environmental protection, EPA and the states should explore incentives concurrently with the technical approaches outlined above.

IX. NEXT STEPS

The strategy for ground water protection that has been proposed in these pages will be evolving, not static. It will be expanded in the future as the new programs now underway are more fully developed, as new information is gained about ground-water resources and threats, and as experience accumulates.

Once approved as a final strategy, the implementation of the strategy will begin through the State/EPA Agreements, EPA's research and development efforts, the Agency's normal regulatory processes, administrative actions and the budget process.

Some questions remain and will be explored during the course of implementing the strategy. An evaluation of the early years of strategy implementation--similar to the public process used to develop this strategy--will enable us to identify the changes and additions needed to improve this ground water protection program.

ACRONYM LIST

BMP	Best Management Practice (Water Quality)
CWA	Clean Water Act; also known as the Federal Water Pollution Control Act (FWPCA)
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
NPDES	National Pollutant Discharge Elimination System (Water Quality)
NRC	Nuclear Regulatory Commission
OWWM	Office of Water and Waste Management
POTW	Publicly-Owned Treatment Works
RCRA	Resource Conservation and Recovery Act; enacted as amendment to the Solid Waste Disposal Act
SDWA	Safe Drinking Water Act; enacted as amendments to the Public Health Service Act
SEA	State/EPA Agreement
TSCA	Toxic Substances Control Act
UIC	Underground Injection Control
USGS	United States Geological Survey

U.S. GOVERNMENT PRINTING OFFICE 1980-0- 341-085/4616